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1985 UPDATE ON JAPAN'S ENERGY PROFILE: CONSERVATION

Summary

Japan continued to moderate its appetite for energy in fiscal 1984 (ended March 31, 1985) while still recording a solid 5.7 percent in real economic growth. The country's dependence on imported oil was the lowest in almost 20 years, dropping below 60 percent. According to the Ministry of International Trade and Industry, this reflects both conservation programs and efforts to develop alternative energy sources. A review of Japan's alternative energy programs appeared in last year's energy report (JEI Report No. 28A, July 20, 1984). In this analysis, the spotlight shifts to the country's conservation programs.

The Aggregate Picture

Japan's consumption of all types of energy climbed just 2.8 percent in fiscal 1984 -- the equivalent of 406 million kiloliters of crude oil -- according to MITI data. This performance represents a significant slowing in the rate of growth of consumption, which moved from -4.8 percent in FY 1982 to 5.3 percent in fiscal 1983. On the supply side, strong growth continued for the second year in a row, with supplies of all energy resources growing 5.3 percent to the equivalent of 436 million kiloliters of crude oil, slightly less than the 6.6 percent growth recorded in FY 1983. Although the wider gap between supplies and consumption implies a buildup of inventories, this did not occur because non-oil energy sources accounted for most of the growth in supply.

A breakdown by source clearly reveals the shift away from imported oil. Increased oil imports made the smallest contribution to the expansion of

Japan's energy supply (see Table 1). The tiny 1.4 percent increase gave oil just a 59.6 percent share of total supplies, compared with 77 percent in 1973. Soaring purchases of natural gas and coal, however, tended to partially offset oil's decline since they too are mostly imported. The sharp decline in hydroelectric output was largely a result of the drought that struck Japan. Finally, nuclear energy appears to be fulfilling its promise as a major energy resource. Nuclear plants reported record-high operating rates in fiscal 1984, helping utilities to score good profits.

Table 1: Japan's Energy Suppply By Source

(in millions of units)

	FY 1983			FY 1984			
	Actual	Crude Oil Equivalent	Share	Actual	Crude Oil Equivalent	Share	Percent Change
Oil (kl)	256.0	256.0	61.9%	259.6	259.6	59.6%	1.4%
Coal (mt)	96.5	73.3	17.7	106.2	80.5	18.5	9.9
Nuclear (kw)	18.5	29.8	7.2	20.7	35.0	8.0	17.5
Natural Gas (kl)	31.2	32.1	7.5	40.0	40.0	9.2	28.0
Hydroelectric (kw)	33.5	22.2	5.4	33.9	19.1	4.4	-14.0
Alternatives (kl)	1.4	1.4	0.3	1.5	1.5	0.4	7.1
Total		414.0	100.0		435.8	100.0	5.3

Source: Ministry of International Trade and Industry

Aggregate consumption statistics reinforce this picture (see Table 2). Oil consumption increased only slightly overall, based on small gains in demand from the industrial and transportation sectors and a significant drop in other uses. In contrast, all other sources racked up 5 percent or higher growth. Another important trend is the 11.5 percent increase in industry's use of propane. Although propane, or what the Japanese call "city gas," supplies only a small part of industry's needs, it is often used in highly efficient co-generation systems -- systems which are gaining more attention from industrialists.

Combined with figures on real gross national product growth, the data on aggregate consumption confirm the upward trend of energy efficiency. In fiscal 1983, the economy consumed 5.3 percent more energy while growing 3.9 percent; the figures for fiscal 1984 were 2.8 percent and 5.7 percent, respectively. Tokyo expects this trend to level out in the future, predicting average annual economic growth of 3 to 5 percent coupled with energy consumption growth of 2 to 3 percent.

Finer Details

A close look at the different energy sources reveals other important trends. The oil industry experienced a relatively good year despite declining

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demand. Refineries ran at an average 67.1 percent of capacity, up over 10 points from the previous two years (see Table 3), while inventories were still reduced significantly. The slump in imported crude oil prices that would have helped brighten oil company balance sheets was partially offset by the soaring value of the dollar (see Table 4). Petroleum refiners were not actually harmed by the weaker yen since they cover any exposure through foreign exchange transactions, but they could not take advantage of the situation either.

Table 2: Japan's Energy Consumption By Source, FY 1984

(in millions of kiloliters of crude oil equivalent and percentage change)

	Industry	Transportation	Other	Total
Oil	85.1	62.1	34.1	181.2
	(1.1%)	(1.8%)	(-5.0%)	(0.1%)
Coal	56.1	0	0.4	56.5
	(5.9)		(-12.8)	(5.8)
Electricity	80.9	3.4	59.4	143.7
	(5.3)	(-1.4)	(4.9)	(5.0)
Propane	2.8	0	9.9	12.7
	(11.5)		(3.2)	(5.0)
Others	11.0	0.3	1.0	12.3
	(4.7)	(3.2)	(9.8)	(5.0)
Total	235.8	65.8	104.8	406.4
	(3.9)	(1.6)	(1.2)	(2.8)

Source: Ministry of International Trade and Industry

The picture for non-crude energy imports was brighter as demand rose across the board (see Tables 5 and 6). Coal imports from new mines in Canada and Australia jumped along with consumption. Purchases of naphtha from foreign suppliers was flat, mainly because importers had overbought in 1983. MITI's efforts to reduce use of heavy fuel oil are having a major impact: consumption by industry and utilities continued to fall in 1984 even as industrial output rose dramatically. With gasoline prices stable during 1984, the demand for liquefied petroleum gas for car fuel made little progress. The resurgence of the petrochemical industry, however, more than made up the difference. Detailed figures on natural gas consumption show strong gains in both residential and industrial uses.

A detailed review of Japan's electric power industry indicates further progress toward weaning the country from dependence on imported oil (see Tables 7 and 8). In order to compensate for hydroelectric power's sharply lower output, generation by oil- and coal-fired as well as nuclear plants was increased. Yet the fact that nuclear power supplied the larger part of the increase shows the strength of Japan's nuclear program. The nuclear trend is likely to accelerate as Japanese utilities bring more than 30 planned nuclear facilities on line and continue their progress toward fast-breeder reactors and fusion reactors.

In terms of consumption, it is clear that industry is making good use of the nuclear bounty. Electricity used for power continues to rise strongly with much of the impetus coming from the manufacturing sector. MITI planners foresee even greater use of electricity since it can be generated from numerous sources.

End-Users: Households

A brief look at household energy needs uncovers one area where conservation efforts are needed. Residential consumption of all types of energy in 1984 showed strong increases across the board (see Table 9). Although a cold winter and hot summer inflated the figures to some degree, it appears that the Japanese consumer is stocking his home with more appliances and is more extravagant when it comes to heating and cooling. While energy-efficient appliances are the norm in Japan today, energy-efficient structures are not. In contrast to the successful U.S. program, Tokyo does not offer homeowners tax incentives to construct energy-wise homes or install better insulation. While some provisions are made for installing solar powered systems, policy remains weak in this area.

End-Users: Industry

Industry accounted for 58 percent of all energy consumed in Japan in fiscal 1984, up slightly from FY 1983's 57.4 percent level. In terms of percentage change, however, industry's needs grew 3.9 percent in FY 1984 compared with FY 1983's 4.2 percent increase. As seen in Table 2, this sector's appetite for every type of energy grew. At the same time, the balance continued to shift against oil in terms of energy sources.

The trend away from oil is clearer when consumption by type of energy is examined (Table 10). The use of gasoline, light and heavy oils declined in almost every sector when 1983 and 1984 are compared. Consequently, the use of other energy sources has expanded, particularly electricity and propane. Since government and business planners see the current global oil surplus as a temporary condition, the drive to squeeze oil's role will continue.

MITI data confirm that industry continues to improve its energy efficiency. When the mining and manufacturing output and energy demand indices are compared, it appears that Japan improved its energy efficiency by 24 percent from fiscal 1979 to fiscal 1984 (Table 11). Between FY 1979 and FY 1982, the improvement resulted from falling energy inputs combined with steady output. Beginning in FY 1983, energy consumption and production both began to climb, but the latter far outpaced the former, driving the output/energy index further down. The trend has apparently started to level off -- 1984's improvement was the smallest in six years.

Furthermore, MITI asserts that the FY 1984 increase in energy consumption by industry due to rising production would have been much greater had it not been for improvements in equipment and management (Table 12). Although the effect of production changes has varied widely over the past five years, savings from conservation and industrial reorganization have had a major restraining influence.

Commercial Conservation

Industrial conservation programs extend far beyond the quantitative reduction of energy needed to produce goods. More efficient white-collar operations, improved methods of generating energy, and energy-efficient products have received at least equal attention.

Many companies have had electricity conservation programs in place for over a decade. More efficient lighting and heating coupled with reduced use yielded immediate savings. Further gains at a much higher cost are now being put into effect: improved wiring and insulation, passive solar architectural designs, and computer-controlled environmental systems (so called "smart office buildings") will continue to reduce consumption.

Among the more promising technologies to augment energy production are high efficiency coal burning systems, bioconversion systems and co-generation, which focuses on the productive use of waste heat. Liquefaction, fluidized-bed furnaces and a number of other innovations are being employed to wring more energy from coal with less pollution. These systems are particularly important to the steel industry, which needs every bit of help to stay internationally competitive. Converting refuse into methanol is the focus of several programs (see Table 13) aimed at utilization by factories and motor vehicles.

Many companies are making a concerted effort to adapt co-generation to their particular needs. This technology offers significant paybacks. Petrochemical, glass, ceramic, steel and other companies produce large amounts of waste heat that can be harnessed to drive electric generators. Conversely, companies that have boiler generators can install heat transfer systems to recapture much of the energy that would be lost out the chimney.

Energy-efficient industrial products are now in widespread use; MITI actually fosters the development of such products by holding annual contests. (The FY 1984 winners are listed in Table 14.) Despite the recent stability of energy prices, companies show no signs of easing their efforts to develop power-saving products and promote them as such.

Conclusion

Japan's drive to reduce the economy's energy requirements have been quite successful. The 1970's oil crises sent shocks throughout the world that are still reverberating strongly in Japan. What has been most impressive is the country's ability to combine a smaller energy appetite with enviable economic performance in terms of output, employment and price stability.

Changing conditions, however, are presenting policymakers with new problems. The global excess of refining capacity has put new pressure on Japan to reorganize its tightly controlled domestic petroleum products market. Bowing to the recent consensus of the International Energy Agency, an advisory council has recommended that Japan liberalize its refined products import policy. The move will surely be opposed by Japanese oil refiners and will undoubtedly give MITI planners headaches for the next few years. Liberalization could yield significant benefits to Japanese consumers in the form of lower prices on certain products, and to Japanese politicians in the

form of increased import figures. It could also increase Japan's vulnerability to world oil market fluctuations, reversing the trend toward reduced dependence on imported oil. Regardless of MITI's decision, changes in the country's energy supply structure will come slowly.

It is clear that the private sector has taken the lead in conservation, while the government has focused more attention on developing alternative energy sources. The drive to establish knowledge-intensive industries as the core of Japan's economy is spurring public and private efforts in areas such as structural ceramics and plastics, bioconversion and high energy physics (fusion) -- all areas which promise significant gains in energy efficiency. Despite a host of uncertainties, conservation will remain a keystone of Japan's energy policies.

For further information, contact Jon Choy.

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The views expressed in this report are those of the author and do not necessarily represent those of the Japan Economic Institute.

Table 3: Japan's Crude Oil Imports, Production and Inventories

(in thousands of barrels)

	Production	Imports	Throughput	Rate of Operation	Inventories
1980	3,177	1,615,480	1,462,123	67.3%	238,020
1981	2,868	1,448,203	1,321,353	60.9	226,302
1982	2,937	1,350,369	1,225,566	56.5	205,916
1983	3,095	1,307,024	1,181,136	56.9	185,870
1984	2,994	1,349,847	1,220,958	67.1	163,905
January	264	114,055	114,460	74.3	174,637
February	239	122,711	118,277	82.0	158,677
March	247	134,152	117,407	76.2	162,967
April	229	118,231	110,791	74.3	159,483
May	257	113,967	99,129	64.3	166,235
June	236	98,624	85,749	57.5	169,723
July	226	108,383	94,042	61.0	173,541
August	214	150,583	96,602	62.7	215,936
September	245	73,637	81,562	54.7	193,795
October	258	103,458	97,640	63.3	185,341
November	277	96,394	99,998	67.0	165,597
December	302	115,654	105,295	68.3	163,905
1985					
January	308	120,265	106,597	69.1	168,207
February	296	116,214	106,408	76.4	168,528
March	308	123,800	102,955	66.8	182,177

Source: Petroleum Association of Japan

Table 4: Price (c.i.f.) of Imported Crude Oil

	Volume (1,000 bbl)	Value ($millions)	Dollars per bbl	Yen per kiloliter
1980	1,600,352	$52,749	$32.97	Y47,197
1981	1,430,623	53,343	37.29	51,387
1982	1,334,958	46,266	34.66	53,906
1983	1,302,055	40,063	30.77	45,923
1984	1,314,034	39,379	29.36	43,713
January	111,314	3,283	29.49	43,374
February	118,950	3,518	29.58	43,532
March	137,386	4,053	29.50	42,454
April	109,069	3,191	29.26	41,426
May	120,441	3,554	29.51	42,224
June	92,897	2,751	29.61	43,127
July	108,622	3,202	29.48	44,262
August	126,146	3,701	29.34	44,969
September	90,614	2,650	29.24	44,698
October	105,540	3,080	29.17	45,267
November	104,684	3,051	29.15	44,748
December	115,371	3,346	29.00	44,892
1985				
January	99,017	2,881	29.10	46,128
February	113,471	3,258	28.71	46,352
March	126,586	3,583	28.30	46,379

Source: Ministry of Finance

Table 5: Japan's Non-Crude Energy Imports

(in thousands of units)

	Coal (mt)	Naphtha (kl)	Fuel Oil (kl)	LPG (mt)	LNG (mt)
1980	68,570	7,363	7,431	9,725	16,324
1981	77,959	7,241	7,404	10,097	16,833
1982	78,535	8,998	6,893	11,861	17,480
1983	75,124	13,096	7,285	10,860	18,748
1984	87,227	13,414	7,342	11,320	25,738
January	6,584	1,347	565	1,066	2,181
February	6,571	1,390	602	773	1,954
March	7,415	727	499	894	2,279
April	7,629	918	807	1,053	1,820
May	7,071	1,113	573	1,119	2,043
June	8,052	970	512	830	1,795
July	7,445	913	705	1,071	2,196
August	7,581	1,253	703	1,011	2,545
September	6,879	963	672	534	2,070
October	7,808	1,156	580	1,062	2,209
November	7,190	1,126	558	877	2,281
December	7,001	1,539	566	1,031	2,366
1985					
January	7,101	1,228	420	720	2,527
February	6,718	1,365	440	946	2,160
March	8,216	1,463	678	1,086	2,556

Table 6: Japan's Consumption of Non-Crude Oil Energy

(in thousands of units)

	Coal (mt)			Heavy Fuel Oil (kl)				LPG (mt)			LNG (mt)	
	Coke	Steel	Power	Agri-culture	Manuf-turing	Ship-ping	Power	Chemi-cals	Power	Motor vehicles	Resi-dential	Power
1980	2,859	58,896	1,671	6,433	43,747	6,154	38,360	4,485	3,327	1,548	3,180	12,554
1981	3,906	60,854	4,082	6,444	35,690	4,730	34,508	4,465	2,707	1,241	3,411	12,857
1982	3,389	59,447	5,233	6,323	30,209	4,365	30,983	4,465	2,707	1,241	3,411	12,857
1983	3,652	54,570	7,742	5,707	27,769	4,112	29,476	4,047	3,082	1,822	4,195	14,039
1984	4,069	62,716	9,424	6,086	26,655	4,909	29,220	5,029	3,381	1,843	5,561	19,606
January	339	4,634	801	613	2,408	396	2,905	403	240	129	678	1,445
February	295	4,775	723	587	2,589	414	3,150	414	290	149	534	1,363
March	386	5,592	685	562	2,531	469	3,045	397	299	168	572	1,650
April	413	5,582	706	445	2,227	400	2,049	398	288	146	426	1,337
May	336	5,372	660	551	2,084	392	1,740	353	270	166	410	1,633
June	261	5,866	694	463	2,094	397	2,080	383	288	163	369	1,369
July	236	5,008	1,138	470	2,094	396	2,616	426	258	154	378	1,761
August	486	5,370	775	493	2,003	411	2,816	488	252	126	400	2,088
September	195	5,004	905	468	2,107	391	2,565	460	272	144	445	1,568
October	447	5,606	776	479	1,902	403	1,992	409	300	171	392	1,760
November	408	5,084	778	440	2,203	388	2,079	438	288	145	577	1,647
December	267	4,824	782	515	2,413	452	2,183	460	336	182	507	1,859
1985												
January	327	4,549	1,221	558	2,445	384	2,308	454	268	135	572	1,898
February	349	4,819	918	502	2,340	419	2,367	397	272	117	441	1,661
March	422	5,694	982	491	2,504	431	2,053	373	299	160	648	1,851

Source: Ministry of International Trade and Industry

Table 7: Japan's Electric Utility Output

(in billions of kilowatt hours)

	Total	Hydro	Thermal	Nuclear
1980	514.05	85.15	346.90	82.01
1981	523.14	83.74	352.18	87.23
1982	522.48	77.34	343.30	101.84
1983	555.49	81.39	360.98	113.12
1984	580.41	68.87	378.32	133.23
January	47.89	4.38	33.65	9.85
February	47.95	3.62	34.95	9.38
March	49.41	3.98	36.87	8.56
April	43.63	7.38	27.47	8.78
May	43.36	7.56	25.03	10.77
June	45.94	7.76	28.15	10.02
July	54.49	8.52	35.46	10.51
August	56.35	6.89	38.34	11.12
September	47.50	4.93	31.24	11.33
October	46.32	3.56	31.07	11.68
November	46.22	3.35	31.10	11.77
December	50.07	3.89	34.02	12.16
1985				
January	50.06	3.55	34.29	12.22
February	46.74	4.06	32.11	10.57
March	49.75	7.41	30.04	12.30

Table 8: Japan's Electricity Consumption

(in billions of kilowatt hours)

			Power				
				Manufacturing			Rail-
	Total	Light	Total	Total	Chemicals	Steel	Roads
1980	464.25	105.27	353.98	190.77	26.79	61.80	12.71
1981	470.56	110.30	360.27	184.29	26.28	58.49	12.86
1982	471.44	112.79	358.65	177.95	29.22	53.69	13.06
1983	499.78	122.22	377.57	182.62	27.55	55.47	13.33
1984	524.53	127.51	397.02	191.97	28.76	57.04	13.13
January	43.87	12.17	31.71	14.87	2.29	4.65	1.23
February	43.65	11.43	32.22	15.24	2.23	4.64	1.13
March	43.34	10.68	32.66	16.03	2.32	4.87	1.19
April	42.12	10.64	31.48	15.33	2.31	4.67	1.03
May	40.30	9.49	30.80	15.70	2.42	4.79	1.03
June	40.83	8.85	31.98	16.25	2.47	4.79	1.02
July	44.60	9.75	34.85	16.58	2.44	4.75	1.13
August	49.41	12.31	37.10	15.77	2.43	4.54	1.19
September	47.77	11.89	35.87	16.10	2.41	4.62	1.03
October	42.19	9.37	32.82	16.62	2.48	4.94	1.07
November	41.40	9.78	31.62	16.20	2.41	4.84	1.07
December	42.81	10.54	32.27	16.18	2.43	4.91	1.12
1985							
January	45.97	12.84	33.14	15.48	2.39	4.72	1.22
February	43.82	11.50	32.32	15.33	2.22	4.55	1.05
March	43.32	10.54	32.78	16.42	2.35	4.92	1.15

Source: Ministry of International Trade and Industry.

Table 9: Household Energy Consumption

	Electricity (mil kwh)	Propane (bil kcal)	Kerosene (1,000 kl)	LPG (1,000 mt)	Other Solids (1,000 mt)	Coal (1,000 mt)
1980	103,199	56,008	16,725	4,984	1,212.3	578.5
1981	108,979	58,178	16,730	5,336	970.0	472.5
1982	110,051	58,200	15,275	5,295	1,173.0	512.8
1983	117,905	60,748	15,928	5,460	1,010.3	509.2
1984	125,588	66,065	17,130	5,696	1,413.2	469.1
January	12,071	8,087	2,774	594	95.1	34.9
February	11,324	7,890	2,911	671	108.9	40.3
March	10,586	7,834	2,509	610	110.2	38.4
April	10,545	7,223	1,119	485	90.2	19.3
May	9,407	5,783	695	464	103.4	26.3
June	8,749	4,242	491	403	111.0	34.5
July	9,620	3,755	443	378	107.8	36.4
August	12,169	3,147	616	303	119.0	33.6
September	11,760	3,047	482	338	150.3	44.7
October	9,243	3,699	822	414	136.9	62.5
November	9,676	4,976	1,488	438	139.2	52.8
December	10,438	6,380	2,781	600	141.2	45.4
1985						
January	12,741	8,257	2,670	602	125.5	26.0
February	11,392	7,678	2,312	554	94.6*	32.5
March	10,447	7,253	n.a.	n.a.	104.7*	42.4

*Partial data only.

Source: Ministry of International Trade and Industry

Table 10: Energy Consumption by Industry by Type

	Total oil equiv. (kl)	Fuels (kl)	Electricity (1,000 kwh)	Steam (mt)	Gasoline (kl)	Light Oil (kl)	Fuel Oil (kl)	LPG (mt)	Coal (mt)	Propane (1,000 cu m)
10a. Metal Mining										
1983	85,704	34,450	521,578	2,468	66	4,408	21,176	24	2,881	0
1st Qtr	22,906	9,961	134,324	842	11	882	6,820	6	279	0
2nd Qtr	18,658	6,329	123,158	541	20	903	3,490	6	712	0
3rd Qtr	20,235	7,433	128,826	412	17	959	3,967	6	896	0
4th Qtr	23,905	10,727	135,270	673	18	1,032	6,899	6	994	0
1984	73,995	25,839	491,902	1,914	63	4,482	12,871	29	2,778	0
1st Qtr	20,593	8,076	131,243	670	20	1,017	4,335	11	871	0
2nd Qtr	17,851	5,963	117,915	383	15	1,137	2,818	6	645	0
3rd Qtr	16,602	4,825	118,486	264	14	1,170	2,126	6	692	0
4th Qtr	18,949	6,975	124,258	597	14	1,158	3,592	6	570	0
1985										
1st Qtr	19,778	7,923	122,182	774	14	1,147	4,477	6	743	0
10b. Coal Mining										
1983	663,943	592,695	719,746	0	12	11,270	4,330	0	586,524	0
1st Qtr	158,457	135,970	207,052	0	3	2,551	1,904	0	125,598	0
2nd Qtr	148,778	130,730	185,087	0	3	2,468	913	0	127,183	0
3rd Qtr	158,848	145,532	171,694	0	3	3,116	1,088	0	142,790	0
4th Qtr	197,860	180,463	155,913	0	3	3,135	425	0	190,953	0
1984	657,159	596,539	633,417	0	12	21,067	2,178	0	592,447	0
1st Qtr	184,713	171,818	135,434	0	3	3,685	634	0	178,921	0
2nd Qtr	147,789	130,439	177,872	0	3	6,147	565	0	118,335	0
3rd Qtr	153,070	137,339	165,643	0	3	5,620	402	0	137,104	0
4th Qtr	171,587	156,943	154,468	0	3	5,615	577	0	158,087	0
1985										
1st Qtr	172,915	159,149	144,320	0	3	6,000	606	0	157,533	0
10c. Textiles										
1983	4,023,117	3,597,195	5,143,101	344,150	412	1,591	2,993,544	90,923	209,494	36,656
1st Qtr	1,047,271	928,678	1,155,105	118,900	103	383	786,915	21,980	47,144	7,429
2nd Qtr	908,597	865,374	1,322,380	83,139	101	383	724,768	22,044	44,327	10,109
3rd Qtr	1,021,717	885,257	1,347,885	70,731	105	380	743,773	22,262	47,190	9,302
4th Qtr	1,045,532	917,886	1,317,731	71,380	103	445	738,088	24,637	70,833	9,816
1984	4,213,267	3,680,691	5,332,631	303,292	390	1,646	2,887,151	110,703	282,458	39,972
1st Qtr	1,107,109	983,639	1,245,361	77,072	96	420	798,139	26,034	68,462	10,099
2nd Qtr	1,034,346	897,629	1,380,588	57,787	106	402	711,341	24,952	67,764	10,218
3rd Qtr	1,017,666	877,084	1,379,836	81,860	93	392	668,746	29,328	73,122	9,216
4th Qtr	1,054,146	922,339	1,326,846	86,573	95	432	708,925	30,389	73,110	10,439
1985										
1st Qtr	1,073,984	938,814	1,245,626	229,403	84	410	688,247	26,541	96,693	10,559

Table 10 - continued

	Total oil equiv. (kl)	Fuels (kl)	Electricity (1,000 kwh)	Steam (mt)	Gasoline (kl)	Light Oil (kl)	Fuel Oil (kl)	LPG (mt)	Coal (mt)	Propane (1,000 cu m)
10d. Pulp, Paper and Cardboard										
1983	10,480,791	9,337,339	11,570,067	590,881	477	1,808	4,705,871	39,491	971,472	15,358
1st Qtr	2,702,898	2,434,898	2,716,460	155,514	122	449	1,268,892	10,357	264,051	3,850
2nd Qtr	2,552,336	2,256,789	2,984,266	152,280	119	455	1,119,246	8,904	233,581	5,536
3rd Qtr	2,535,243	2,244,598	2,921,922	138,382	114	423	1,098,027	9,245	221,503	2,970
4th Qtr	2,690,314	2,401,054	2,947,419	144,705	122	481	1,219,706	10,985	252,337	3,002
1984	10,731,896	9,568,600	11,708,214	857,172	439	1,792	4,699,063	42,536	1,015,973	20,404
1st Qtr	2,774,319	2,501,497	2,742,982	213,908	114	507	1,282,060	11,266	272,822	4,753
2nd Qtr	2,628,898	2,327,426	3,009,592	248,166	106	446	1,130,126	10,485	244,032	5,228
3rd Qtr	2,574,194	2,282,280	2,942,548	201,712	108	402	1,084,223	9,694	222,912	4,729
4th Qtr	2,754,485	2,457,397	3,013,092	193,386	111	437	1,202,654	11,091	276,207	5,694
1985										
1st Qtr	2,803,522	2,525,093	2,798,383	221,911	112	438	1,225,479	11,294	298,596	6,972
10e. Chemicals										
1983	57,216,628	53,663,496	35,000,370	25,001,640	641	148,347	5,919,405	2,499,865	13,736,636	39,381
1st Qtr	14,318,711	13,088,243	6,762,101	5,658,974	164	16,418	1,541,886	678,369	3,244,622	9,902
2nd Qtr	13,653,886	12,595,987	9,154,360	5,153,172	156	60,198	1,425,456	501,075	3,451,977	9,404
3rd Qtr	14,876,064	13,611,299	9,341,328	5,377,255	154	37,934	1,489,988	632,404	3,533,950	8,725
4th Qtr	14,367,967	14,367,967	9,742,581	5,812,239	167	33,797	1,462,075	688,017	3,506,087	11,350
1984	66,206,821	60,967,640	40,109,747	21,720,660	640	87,052	5,879,700	3,049,413	23,061,710	42,166
1st Qtr	16,196,226	14,891,257	9,525,653	6,207,630	158	48,622	1,613,605	731,095	3,531,067	8,914
2nd Qtr	16,063,222	14,709,775	10,673,116	5,055,157	159	18,737	1,390,244	661,518	6,274,570	9,959
3rd Qtr	16,823,441	15,545,332	9,882,037	5,083,529	152	5,724	1,401,731	853,480	6,514,461	11,009
4th Qtr	17,123,932	15,821,276	10,028,941	5,374,344	171	13,969	1,474,120	803,320	6,741,612	12,284
1985										
1st Qtr	16,937,396	15,663,378	5,458,744	157	6,182	1,587,065	668,642	6,664,066	11,891	
10f. Petrochemicals										
1983	10,671,359	10,252,467	2,862,854	2,309,131	622	2,715	3,659,233	170,909	0	43
1st Qtr	2,915,229	2,809,829	681,265	633,604	159	496	1,114,860	33,908	0	12
2nd Qtr	2,453,448	2,353,574	668,978	568,849	151	603	878,077	35,565	0	10
3rd Qtr	2,500,956	2,395,241	763,243	527,906	164	958	764,183	45,538	0	10
4th Qtr	2,801,726	2,693,823	749,368	578,772	148	658	902,113	55,898	0	11
1984	10,759,857	10,355,784	3,034,433	2,389,831	554	2,250	3,287,610	195,084	0	52
1st Qtr	2,973,144	2,861,401	727,849	664,235	155	651	975,865	48,604	0	16
2nd Qtr	2,552,256	2,446,591	730,440	571,325	135	754	803,053	44,199	0	13
3rd Qtr	2,484,769	2,410,914	812,913	521,971	127	457	645,441	58,227	0	10
4th Qtr	2,749,688	2,636,878	763,231	632,300	137	388	863,251	44,054	0	13
1985										
1st Qtr	2,882,478	2,762,720	767,584	728,642	118	383	987,601	40,247	0	9

Table 10 - continued

	Total oil equiv. (kl)	Fuels (kl)	Electricity (1,000 kwh)	Steam (mt)	Gasoline (kl)	Light Oil (kl)	Fuel Oil (kl)	LPG (mt)	Coal (mt)	Propane (1,000 cu m)
10g. Rubber Products										
1983	421,307	511,718	1,372,386	442	563	126	256,992	9,883		
1st Qtr	109,581	80,785	314,761	0	108	25	70,647	2,537	0	8,140
2nd Qtr	99,951	285,080	337,420	0	148	37	59,948	2,287	0	2,009
3rd Qtr	100,049	66,835	362,702	442	149	29	57,925	2,304	0	2,005
4th Qtr	111,726	79,018	357,503	0	158	35	68,472	2,755	0	1,985
1984	428,331	297,132	1,434,033	0	685	129	257,769	10,200		2,141
1st Qtr	120,508	88,465	350,240	0	167	32	77,142	2715	0	8,116
2nd Qtr	101,965	69,362	356,360	0	179	35	59,801	2,475	0	2113
3rd Qtr	98,234	64,483	368,901	0	171	30	55,841	2,403	0	2,072
4th Qtr	107,624	74,822	358,532	0	168	32	64,985	2,607	0	1,947
1985									0	1,984
1st Qtr	114,253	82,370	348,478	0	160	33	71,438	2,527	0	1,889
10h. Ceramics, Mineral and Glass Products										
1983	15,482,503	13,704,248	17,650,915	889,485	1,554	28,424	3,007,179	192,953	8,841,061	74,080
1st Qtr	3,851,741	3,406,708	4,298,155	252,677	411	6,956	723,746	51,673	2,130,041	16,177
2nd Qtr	3,766,424	3,330,893	4,005,142	183,705	394	6,816	737,637	47,181	2,114,575	16,991
3rd Qtr	3,839,295	3,411,167	3,923,939	214,477	371	7,164	777,798	45,824	2,194,552	18,749
4th Qtr	4,025,043	3,555,480	5,423,679	238,626	378	7,488	767,998	48,275	2,401,893	22,163
1984	14,493,878	12,694,184	16,864,678	1,014,983	1,362	26,063	2,991,235	209,237	9,234,246	94,106
1st Qtr	3,663,007	3,191,379	4,355,255	274,389	346	6,729	782,611	50,174	2,159,973	21,493
2nd Qtr	3,467,048	3,022,278	4,107,869	228,124	354	6,521	732,295	51,462	2,170,662	22,981
3rd Qtr	3,515,642	3,090,588	3,974,390	244,379	320	6,201	751,764	52,169	2,273,811	22,997
4th Qtr	3,848,181	3,389,939	4,427,164	268,091	342	6,612	724,565	55,432	2,629,800	26,635
1985										
1st Qtr	3,426,340	3,000,650	4,106,859	285,496	311	5,891	738,150	54,728	2,150,223	27,289
10i. Iron and Steel										
1983	45,462,302	40,204,863	53,038,384	3,822,903	6,307	66,621	2,194,392	412,776	25,005,508	98,590
1st Qtr	10,996,218	9,706,519	13,144,789	906,218	1,487	17,822	570,391	111,274	6,010,547	25,315
2nd Qtr	11,152,201	9,831,906	13,307,969	800,322	1,702	17,106	527,998	99,817	6,052,492	20,007
3rd Qtr	11,424,961	10,152,018	12,807,441	905,873	1,586	15,211	535,090	99,128	6,377,992	25,688
4th Qtr	11,888,922	10,514,420	13,778,185	1,210,490	1,532	16,482	560,913	102,557	6,564,477	27,580
1984	50,509,329	46,178,724	56,028,722	3,086,995	6,208	61,699	2,254,793	419,111	35,313,446	124,619
1st Qtr	12,083,344	10,723,888	14,745,412	1,285,683	1,597	16,867	619,319	108,464	6,684,202	28,028
2nd Qtr	12,799,775	12,456,987	13,828,439	574,190	1,630	15,889	557,530	101,554	9,406,381	30,536
3rd Qtr	12,766,537	11,487,347	13,362,853	570,258	1,445	15,458	532,236	100,748	9,611,619	32,311
4th Qtr	12,859,673	11,510,502	14,092,018	656,864	1,536	13,485	545,708	108,345	9,611,244	33,744
1985										
1st Qtr	12,847,505	11,543,614	13,667,257	607,357	1,500	13,433	556,972	108,880	9,595,664	37,034

Table 10 - continued

	Total oil equiv. (kl)	Fuels (kl)	Electricity (1,000 kwh)	Steam (mt)	Gasoline (kl)	Light Oil (kl)	Fuel Oil (kl)	LPG (mt)	Coal (mt)	Propane (1,000 cu m)
					10j. Non-Ferrous Metal Ores and Manufactures					
1983	4,375,242	2,880,660	14,609,000	1,054,817	1,074	6,320	1,216,257	184,255	870,492	41,726
1st Qtr	1,113,383	760,031	3,543,701	678,471	263	1,550	342,282	48,636	209,217	9,574
2nd Qtr	1,027,525	652,356	3,630,200	124,201	267	1,554	261,844	44,285	201,124	9,803
3rd Qtr	1,077,577	703,368	3,607,840	116,371	271	1,547	291,102	43,557	228,108	10,882
4th Qtr	1,156,757	764,905	3,827,259	135,774	273	1,669	321,029	47,777	232,043	11,467
1984	4,427,235	2,820,284	15,983,875	635,990	1,159	6,781	1,076,750	192,142	868,317	49,906
1st Qtr	1,155,894	763,064	3,974,317	152,413	295	1,741	320,570	48,905	231,702	12,117
2nd Qtr	1,072,471	661,882	4,020,691	166,651	301	1,656	253,969	46,649	191,521	12,259
3rd Qtr	1,087,063	688,946	3,926,372	146,838	273	1,618	253,160	45,607	234,225	11,847
4th Qtr	1,111,807	706,392	4,062,495	170,088	290	1,766	249,051	50,981	210,869	13,683
1985										
1st Qtr	1,124,699	737,405	3,867,062	179,422	272	1,756	264,899	49,221	243,104	14,446
					10k. Machinery					
1983	13,676,921	10,778,350	31,682,053	0	103,466	66,043	1,456,965	347,114	889	377,619
1st Qtr	3,542,895	2,861,352	7,449,429	0	26,108	16,816	523,683	93,638	320	97,213
2nd Qtr	3,211,280	2,506,830	7,699,800	0	26,331	16,501	277,011	84,689	160	88,655
3rd Qtr	3,316,994	2,552,765	8,353,194	0	25,065	15,746	264,099	79,078	154	86,699
4th Qtr	3,605,752	2,857,403	8,179,630	0	25,962	16,980	392,172	89,709	255	105,052
1984	15,249,193	12,102,100	34,398,450	0	106,685	71,101	1,570,753	362,210	1,044	430,882
1st Qtr	3,977,599	3,224,280	8,233,956	0	26,054	17,653	620,409	97,839	230	114,347
2nd Qtr	3,673,631	2,905,169	8,399,466	0	27,158	17,776	310,522	87,816	262	100,863
3rd Qtr	3,705,251	2,883,592	8,980,910	0	25,611	17,472	264,989	80,923	301	97,092
4th Qtr	3,892,712	3,089,059	8,784,118	0	27,862	18,200	374,833	95,632	251	118,580
1985										
1st Qtr	4,095,903	3,298,245	8,718,587	0	27,034	18,003	554,214	101,095	147	124,842

Source: Ministry of International Trade and Industry

Table 11: Japan's Industrial Energy Efficiency

	Industrial Production Index (1980 = 100)	Industrial Energy Consumption Index (millions of kl of oil)	Derived Energy Efficiency Index (1979 = 100)
FY 1979	99.0	231	100
FY 1980	99.1	218	94
FY 1981	99.6	202	87
FY 1982	98.1	186	81
FY 1983	103.9	191	79
FY 1984	112.4	198	76

Source: Ministry of International Trade and Industry

Table 12: Composition of Industrial Energy Consumption Changes in Japan

(in millions of kiloliters of crude oil equivalent)

	Overall Change in Consumption	as a result of: Output Changes	Industrial Structure Changes	Unit of Measure Changes
FY 1980	-10.1	0.2	-7.4	-2.9
FY 1981	-13.8	1.0	-4.8	-10.0
FY 1982	-9.6	-2.8	-2.1	-4.7
FY 1983	5.3	10.4	-1.7	-3.4
FY 1984	7.2	14.9	-4.1	-3.6

Source: Ministry of International Trade and Industry

Table 13: Commercial Energy Generating Projects, FY 1985

Project	Participants
• Methanol gas turbine-related technology	Japan Automotive Research Institute
• High-efficiency production process for high-calorie propane	Saibu Gas Co., Ltd.; Mitsubishi Petrochemical Engineering Co., Ltd.
• High-efficiency combustion, highly dispersed powdered coal-fueled, general purpose boiler	Hitachi, Ltd.
• Methanation, high-temperature, high-pressure, water/steam production system	Kobe Steel, Ltd.
• Substitution of natural gas for petroleum product (LPG) fuels in gas coke ovens	Kansai Coke and Chemicals, Co., Ltd.
• Powdered coal burner using an oxygen pre-heater	Nippon Sanso K.K.
• Heating equipment using liquid fuels derived from biomass	Mitsubishi Heavy Industries, Ltd. Yanmar Deisel Engine Co., Ltd.
• New compound fuels based on various liquified fuels and charcoal products	Shinagawa Fuel Co., Ltd.
• Solar battery-powered, mobile, high-efficiency hydrogen production system	Hokusan Ltd.
• Wave-powered heat recovery system	Taisei Corp.
• High-temperature, separation energy recovery system using heat-proof parts	Fuji Electric Co., Ltd.
• Blast furnace heat utilization system	Nippon Sheet Glass Co., Ltd.
• Efficient heat systems using metallic hydrogen	Matshushita Industrial Electric Co., Ltd.; Sekisui Chemical Co., Ltd.; Chuo Denki Kogyo Co., Ltd.; Nippon Chemical Technology Co., Ltd.
• Energy-efficient, high-density mechanical separation system	Meidensha Electric Mfg., Co., Ltd.
• Hot water and cooling/heating system using compound energy sources	Sanden Corp.
• Household, multi-stage, heat collector and heat management system	Matsushita Jusetsu Kiki K.K.
• High-efficiency methane fermentation system	Research Union for New Manufacturing Technology of Household Chemical Products

Table 14: MITI Citations for Energy Efficient Products, FY 1984

Product	Company
• Diesel total-energy system	Yanmar Diesel Engine Co., Ltd.
• Lightweight, keyless, relief rotary printing press	Tokyo Kikai Seisakusho, Ltd.
• Engine-type concrete breaker	Yamada Heavy Machinery Co., Ltd.
• High-frequency, 4-quadrant chopper control device	Mitsubishi Electric Corp.
• Main marine diesel engine oil cooler using crude oil or waste heat	Matsui Iron Works Co., Ltd.
• Energy-efficient hydraulic system for hydraulic power shovels.	Komatsu, Ltd.
• Coke-burning air/water heater	Yoshimine Boiler Industry Co., Ltd.
• Energy-efficient, self-contained steam generator for steam-powered equipment	Kimura Chemical Plants Co., Ltd.
• Internally installed, blast furnace super-heating gas generator (oxygen reduction cartridge-type)	Chugai Ro Co., Ltd.
• High-efficiency, counter-rotating steam turbine	Mitsubishi Heavy Industries, Ltd.
• High-capacity, high-performance, multistage centrifugal compressor	Hitachi, Ltd.
• Steam temperature estimator/control device for boilers	Hitachi, Ltd.
• Free-floating steam trap	TLV Co., Ltd.
• Water-sprinkling, moisture-checking blast furnace device	Nippon Steel Corp.